PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-298224
(43)Date of publication of application : 24.10.2000

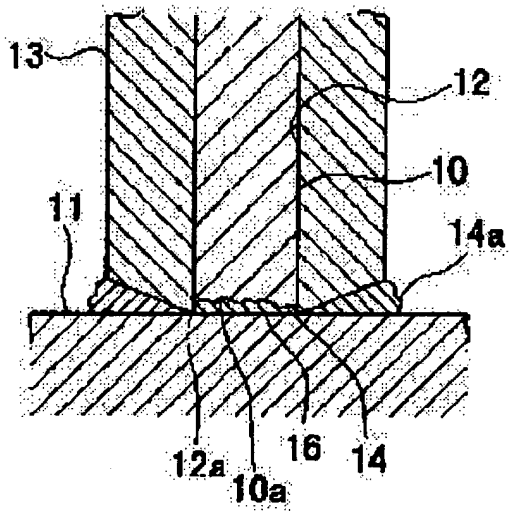
(51)Int.Cl. G02B 6/36
G02B 6/10

(21)Application number : 11-105908
(22)Date of filing : 13.04.1999

(71)Applicant : MITSUBISHI RAYON CO LTD
(72)Inventor : ISHIKAWA RYUICHI
WATANABE YASUSHI
SUGIURA MASAYUKI

(54) END-SURFACE PROCESSING METHOD FOR OPTICAL FIBER

(57)Abstract:
PROBLEM TO BE SOLVED: To actualize an end-surface processing method for optical fiber which will not impair optical transmission capability and eliminates the need for controlling the projection length of the tip of an optical fiber as before.
SOLUTION: This method is adopted which has a process for inserting an optical fiber 10 into a guide hole 12 as the columnar space formed in a ferrule 13 as an optical fiber hold part and holding it at right angles to a heating surface 11, a process for arranging a filler 14 having a same refractive index with the core of the optical fiber 10 between an end surface 10a and the heating surface 11, and a process for pressing a tip peripheral edge 12a formed at the tip in the ferrule 13 on the side of the heating surface 11, in contact with the heating surface 11 and depositing the filler 14 on the end surface 10a.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the end-face art of an optical fiber which makes the end face of an optical fiber graduate using a smooth heating surface Between the process which inserts said optical fiber into the guide hole which is the cylindrical shape-like space formed in the optical fiber attaching part, and holds it at right angles to said heating surface, and said end face and said heating surface The core of said optical fiber, and the process which arranges the filler which has a rate of the isometropia, The end-face art of the optical fiber characterized by pressing the tip periphery formed at the tip by the side of said heating surface of said optical fiber attaching part so that it may be made to stick to said heating surface, and having the process which carries out joining of said filler to said end face.
[Claim 2] It is the end-face art of the optical fiber characterized by forming said guide hole in the interior of a ferrule in the end-face art of an optical fiber according to claim 1 at the same axle, using a ferrule as said optical fiber attaching part, and forming the taper side which is tapering off toward said tip periphery at the tip periphery section of this ferrule.
[Claim 3] the end-face art of an optical fiber according to claim 1 or 2 -- setting -- the inside diameter of said guide hole, and abbreviation -- the end-face art of the optical fiber characterized by using said circular end face of the pillar-shaped object which has the circular end face of the same outer-diameter dimension as a heating surface.
[Claim 4] It is the end-face art of the optical fiber characterized by said filler being said core and this quality of the material in the end-face art of an optical fiber given in either of claims 1-3.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the end-face art of the optical fiber made from plastics used for optical transmission.
[0002]
[Description of the Prior Art] The optical fiber made from plastics covers with the low clad made of fluorination methacrylic resin of a refractive index the core which consists of fiber, such as methacrylic resin, rather than this core, and is used as a light guide for optical transmission etc. On the occasion of application to the optical transmission of this kind of optical fiber, it is required that that end face should be processed as flat and smooth as possible. That is, since the light transmitted as finishing of this end face is coarse starts scattered reflection and produces optical loss, in order to stop this as much as possible, there is the need of finishing flat and smooth.
[0003] There are a polish approach graduated by grinding an end face as main things of such an approach of finishing, for example, a free cut approach graduated by cutting an end face, a hot plate approach which graduates an end face by pressing against a smooth heating surface. Although the polish approach has the advantage in which the smooth side of a high precision is acquired, it also has the demerit in which processing takes time amount. Moreover, although it has the advantage in which a free cut approach can be processed in a short time, it also has the demerit in which the smooth nature of a processing side is low.
[0004] The hot plate approach has the outstanding features that the end face of a precision higher than a free cut approach can be processed rather than a polish approach in a short time, to these. The detail of the end-face art of the conventional optical fiber by this hot plate approach is explained to below in connection of the optical cable to F07 connector plug, referring to a drawing for an example.
[0005] As shown in drawing 7 , optical fiber 2b is first changed into an unreserved condition partially by stripping off jacket 2a of an optical cable 2 by predetermined die length (for example, about 7mm) using a stripper 1. And after inserting optical fiber 2b into insertion hole 3a currently formed in F07 connector plug 3 so that only a predetermined die-length dimension (for example, about 0.3mm) may project from the tip of a ferrule 4, a stopper 5 is pressed fit in stopper installation section 3b of this F07 connector plug 3. Since jacket 2a in F07 connector plug 3 is put between F07 connector plug 3 and a stopper 5 by this press fit, an optical cable 2 will be fixed to F07 connector plug 3 improper [an extraction] by it.
[0006] Thus, end-face processing is made by the hot plate heater 6 which shows optical fiber 2b of the optical cable 2 attached in F07 connector plug 3 to drawing 8 . That is, heating surface 6a is prepared, this is heated at about 160 degrees C, and optical fiber 2b is pressed against the hot plate heater 6 the F07 whole connector plug 3 for [for / 5 seconds / -] 10 seconds perpendicularly [here]. It presses, and drawing 9 is front optical fiber 2b, and is in the condition of having projected only about 0.3mm from the tip of a ferrule 4, as [mentioned / above]. In addition, although F07 connector plug 3 of this explanation has the ferrule 4 of a pair, in drawing 9 and drawing 10 which are explained below, it illustrates optical fiber 2b in ferrule 4 of one of

the two, and continues explanation.
[0007] As shown in drawing 9 , guide hole 4a which is the cylindrical shape-like space where optical fiber 2b is inserted in a ferrule 4, and taper hole 4b which is the space of the truncated-cone configuration opened toward the tip of a ferrule 4 from the lower limit of this guide hole 4a are formed. Moreover, although the gap space 7 is formed between taper hole 4b and optical fiber 2b, the volume of this gap space 7 has come to spread the volume for a lobe of optical fiber 2b, abbreviation, etc.
[0008] Since the volume of the gap space 7 and the volume for said lobe spread abbreviation etc. and it is carried out as drawing 10 pressed, and it is inner optical fiber 2b and being mentioned above, the amount of said lobe carries out melting deformation with the heat transfer from heating surface 6a so that the gap space 7 may be filled. Thus, while the amount of [of fabricated optical fiber 2b] point becomes a breadth configuration the end corresponding to the configuration of taper hole 4b, the apical surface 2c is evenly fabricated by sticking to smooth heating surface 6a.
[0009] Then, drawing 10's pressing and maintaining a condition, by stopping heating of heating surface 6a, it is cooled and solidified, with smooth apical surface 2c maintained, and end-face processing completes a part for the point of optical fiber 2b. In addition, although what has spot facing hole 4c shown in drawing 11 instead of taper hole 4b is put in practical use, in order to miss that into which it melted for the lobe [optical fiber 2b] like [this] the ferrule 4 of drawing 10 , spot facing hole 4c is prepared.
[0010]
[Problem(s) to be Solved by the Invention] By the way, in the end-face art of the conventional optical fiber by the hot plate approach of the above-mentioned explanation, it had the problem explained below. Namely, although taper hole 4b and spot facing hole 4c are prepared in the ferrule 4 in order to avoid facing carrying out melting of the tip and obtaining smooth apical surface 2c, and that into which it melted for said lobe flowing in between the apical surface of a ferrule 4, and heating surface 6a, and becoming weld flash Consequently, the amount of [of optical fiber 2b] point becomes the tip configuration where the path as shown in drawing 10 or drawing 11 spread.
[0011] If such optical fiber 2b is use into an optical transmission path , since joint loss will become large by considering the configuration for said point as a cause , when using it , for example for the large optical fiber for a communication link of a band , it is optimal that making as small as possible dimension **h of the ferrule 4 show in drawing 10 and drawing 11 in order to reduce the effect as much as possible sets to dimension **h**0 desirable still more preferably . However, although it is required that the ejection die length for a lobe of optical fiber 2b should be controlled to a very short thing according to this in order to make this dimension **h small When exact control of such a very small dimension is difficult and ejection die length is too long, overflow into the apical surface of a ferrule 4, adhere, or Or when ejection die length is too short, the problem of being unable to form smooth apical surface 2c, without the ability fully sticking to heating surface 6a will arise.
[0012] Moreover, in order to avoid such a problem, when it is going to secure a certain amount of dimension **h, a clad mixes in the core of return and optical fiber 2b so that the fusion part of optical fiber 2b which escaped to the gap space 7 other than the problem of the above-mentioned joint loss may concentrate toward an axis again, and there is a possibility of causing the further trouble to optical transmission capacity.
[0013] This invention is made in view of the above-mentioned situation, in end-face processing of an optical fiber, does not cause trouble to optical transmission capacity, and aims at offer of the end-face art of an optical fiber without the need of controlling the ejection die length at the tip of an optical fiber like before.
[0014]
[Means for Solving the Problem] The following means were used for the end-face art of the optical fiber of this invention in order to solve the above-mentioned technical problem. Namely, the end-face art of an optical fiber according to claim 1 In the end-face art of an optical fiber which makes the end face of an optical fiber graduate using a smooth heating surface Between

the process which inserts said optical fiber into the guide hole which is the cylindrical shape-like space formed in the optical fiber attaching part, and holds it at right angles to said heating surface, and said end face and said heating surface It is characterized by pressing the tip periphery formed at the tip by the side of the core of said optical fiber, the process which arranges the filler which has a rate of the isometropia, and said heating surface of said optical fiber attaching part so that it may be made to stick to said heating surface, and having the process which carries out joining of said filler to said end face.

[0015] According to the end-face art of the optical fiber of the claim 1 above-mentioned publication, first, while inserting an optical fiber and fixing in a guide hole, a filler is arranged so that it may be located between the end face of an optical fiber, and a heating surface. Then, a filler is put between the end face of an optical fiber, and a heating surface by turning and pressing the tip periphery of a guide hole against a heating surface. The filler at this time is fused with the heat transfer from a heating surface, and it is fabricated by deforming into the configuration stuck to a smooth heating surface flat and smooth while it flows in in the crevice of the irregularity formed in the end face and fills this.

[0016] The end-face art of an optical fiber according to claim 2 is characterized by forming the taper side where said guide hole is formed in the interior of a ferrule at the same axle, and is tapering off toward said tip periphery at the tip periphery section of this ferrule, using a ferrule as said optical fiber attaching part in the end-face art of an optical fiber according to claim 1.

[0017] According to the end-face art of the optical fiber of the claim 2 above-mentioned publication, it becomes a sharp point by making the point of a ferrule into the taper side of a configuration [taper / off] toward a tip periphery.

[0018] the end-face art of an optical fiber according to claim 3 — the end-face art of an optical fiber according to claim 1 or 2 — setting — the inside diameter of said guide hole, and abbreviation — it is characterized by using said circular end face of the pillar-shaped object which has the circular end face of the same outer-diameter dimension as a heating surface.

[0019] According to the end-face art of the optical fiber of the claim 3 above-mentioned publication, in case an optical fiber presses, these carry out the duty of the cutting edge which cuts off the flash part of a filler by making the periphery of a circular end face, and the tip periphery of a guide hole agree. Furthermore, since the apical surface of a ferrule does not contact a heating surface, a filler is pressed beyond the need and this becomes easy to stick to the apical surface of a ferrule.

[0020] The end-face art of an optical fiber according to claim 4 is characterized by said filler being said core and this quality of the material in the end-face art of an optical fiber given in either of claims 1-3.

[0021] According to the end-face art of the optical fiber of the claim 4 above-mentioned publication, the optical properties that the filler was filled up with making the quality of the material of a filler into the same quality of the material as the core of an optical fiber, such as a refractive index of a part, and thermal properties, such as a rate of a heat shrink, become the same as the core of an optical fiber body.

[0022]

[Embodiment of the Invention] Although the end-face art of the optical fiber of this invention presses the end face of an optical fiber against a smooth heating surface, makes it graduate, and it explains each of that example of an operation gestalt below, referring to a drawing, it is needless to say that this invention is not that by which a limited interpretation is carried out at them. In addition, also in each example of an operation gestalt, the case where an optical fiber is attached in F07 connector plug shall be explained to an example.

[0023] [Example 1 of an operation gestalt] The example 1 of an operation gestalt is explained first, referring to drawing 1 - drawing 3 . The process which strips off jacket 2a of an optical cable 2, and changes optical fiber 2b into an unreserved condition partially is the same as that of what was explained by the Prior art.

[0024] In this example 1 of an operation gestalt, an optical fiber 10 is inserted into the ferrule 13 (optical fiber attaching part) by which the guide hole 12 which is cylindrical shape-like space was formed in the interior in the shape of the same axle. Between the process held at right angles to

the heating surface 11 of a hot plate heater, and end-face 10a of an optical fiber 10 and a heating surface 11 The core of an optical fiber 10, and the process which arranges the filler 14 which has a rate of the isometropia, While tip periphery 12a formed at the tip (tip which turned to the heating surface 11 side of said optical fiber attaching part) of the guide hole 12 is pressed so that it may be made to stick to a heating surface 11, and carrying out joining of the filler 14 to end-face 10a As compared with the former, it differs in that it has the process which cuts out from between tip periphery 12a and heating surfaces 11 flash section 14a of the filler 14 extruded outside by tip periphery 12a.

[0025] Furthermore, in this example 1 of an operation gestalt, it differs from the ferrule 4 explained by the Prior art in that the taper side 15 which is tapering off toward tip periphery 12a at the tip periphery section of a ferrule 13 is formed. When it sees as this taper side 15 in the cross section (cross section shown in drawing 1) which passes along the axis of a ferrule 13, the include angle alpha with a virtual flat surface perpendicular to said axis to make Although suitably set up from the range of zero < alpha< 90 degrees in consideration of the detachability of the difficulty of manufacture of a ferrule point, and the flash section of a filler, the configuration of the receptacle combined with a ferrule, etc., since manufacture is easy, it is desirable that it is the range which is ten - 60 degrees.

[0026] If detailed explanation is given to below, after inserting an optical fiber 10 in the same axle and bringing the end-face 10a close as much as possible into the guide hole 12 first at tip periphery 12a, the jacket which covers an optical fiber 10 with a caulking etc. and which is not illustrated is fixed to F07 connector plug improper [an extraction]. Then, while a ferrule 13 and the guide hole 12 hold a ferrule 13 above the heating surface 11 so that a perpendicular may be made to a heating surface 11, they show and press against drawing 1 by laying a filler 14 on a heating surface 11 so that it may be located between end-face 10a of an optical fiber 10, and a heating surface 11, and will be in a front condition.

[0027] As for the filler 14 used here, it is desirable to have a bead configuration and to have the same optical property (a refractive index to be the same at least) as the core of an optical fiber 10 and the same thermal property (for the rate of a heat shrink etc. to be the same) as the quality of the material, and it is more desirable to consider as a core and this quality of the material.

[0028] Next, a ferrule 13 is dropped with the perpendicular condition over a heating surface 11 maintained, and a filler 14 is put between tip periphery 12a and a heating surface 11. While fusing the filler 14 at this time with the heat transfer from the heating surface 11 heated by about 160 degrees C, flowing in in the crevice of the irregularity formed in end-face 10a of an optical fiber 10 and filling this, what became excessive is extruded outside from between tip periphery 12a and heating surfaces 11, and is set to flash section 14a.

[0029] Furthermore, while tip periphery 12a will contact a heating surface 11 closely and flash partial 14a will be divided from optical fiber 10 body as shown in drawing 2 if push reliance is advanced, the field adjacent to the heating surface 11 of a filler 14 sticks to the smooth heating surface 11, and end-face processing is carried out flat and smooth.

[0030] Even if the filler 14 with which it filled up in the guide hole 12 at this time of pressing tends to spread in the direction of a path of an optical fiber 10, since it has received regulation by the guide hole 12, it can spread no longer. Thereby, the cross-section configuration does not become large [to breadth] at last like before, but a part for the point of an optical fiber 10 is fabricated by the right circular cylinder configuration where the fixed outer-diameter cross section was maintained. Then, by stopping heating of a heating surface 11, drawing 2's pressing and maintaining a condition, a filler 14 is solidified by heat dissipation cooling, it is smooth and the flat side 16 which makes a periphery tip periphery 12a of a ferrule 13 is formed. At this time, flash section 14a is also solidified to coincidence.

[0031] And as shown in drawing 3 , by raising a ferrule 13 above the heating surface 11, flash section 14a is removed and installation is completed. Even if flash section 14a adheres to a ferrule 13 at this time, since that adhesion force is not strong, it is simply removed by blasting of Ayr etc. by the reason mentioned later. In the receptacle which is not illustrated, F07 connector plug after this installation is compared with other optical fibers, and is connected, and it acts as

Michimitsu through this connection part, and it is measuring the quantity of light which comes out from the other end, and evaluation of joint loss is performed.
[0032] Since according to the end-face art of the optical fiber of this example 1 of an operation gestalt said insufficient part is filled with a filler 14 and fabricated by carrying out melting of the filler 14 which has the core and the rate of the isometropia of an optical fiber 10, and being filled up with the insufficient part of end-face 10a of an optical fiber 10 flat and smooth, it is not necessary to cause trouble to optical transmission capacity and to control the ejection die length at the tip of an optical fiber 10 like before.
[0033] Moreover, since it becomes a sharp point by making the tip periphery section of a ferrule 13 into the taper side 15 of the tapering configuration which goes to tip periphery 12a according to the end-face art of the optical fiber of this example 1 of an operation gestalt, it becomes possible by making a heating surface 11 contact tip periphery 12a to cut overflowing excessive flash section 14a easily and certainly. Furthermore, since this taper side 15 does not contact a heating surface 11, flash section 14a is pressed beyond the need, it becomes possible to prevent this becoming easy to stick to the point of a ferrule 13, and it becomes possible to remove flash section 14a from a ferrule 13 easily by blasting of Ayr etc.
[0034] Moreover, since the optical properties of the part into which the filler 14 was filled up with making the quality of the material of a filler 14 the same as the quality of the material of the core of an optical fiber 10, such as a refractive index, become the same as the core of an optical fiber 10 according to the end-face art of the optical fiber of this example 1 of an operation gestalt, optical transmission capacity is not reduced. Furthermore, since the thermal properties of the part with which the filler 14 was filled up, such as a rate of a heat shrink, also become the same as the core of an optical fiber 10, it also becomes possible to prevent fault, such as to separate and to fall from end-face 10a after cooling.
[0035] The example 2 of an operation gestalt of this invention is explained to below, referring to the [example 2 of an operation gestalt] next drawing 4 - drawing 6 . In addition, in this example 2 of an operation gestalt, the same sign is given to the same component as what was explained by drawing 1 of the above-mentioned example 1 of an operation gestalt - drawing 3 , and the explanation is omitted.
[0036] The point that not the taper side 15 but the apical surface 20 of a hollow circle configuration is formed in a part for the point of a ferrule 13 in this example 2 of an operation gestalt as compared with the above-mentioned example 1 of an operation gestalt, the inside diameter d1 (for example, 1 millimeter) of the guide hole 12, and abbreviation — with the point that the cylindrical shape-like projection (pillar-shaped object) 21 which makes circular heating surface 21a of the same outer-diameter dimension d2 (for example, 1 millimeter) an upper limit side is formed The points which have adopted the filler 22 of a sheet configuration (100 micrometers in for example, thickness) differ.
[0037] First, an optical fiber 10 is inserted into the guide hole 12, and ten is fixed toFoptical fiber 07 connector plug improper [an extraction] by a caulking etc. Then, while a ferrule 10 and the guide hole 12 hold a ferrule 13 above the heating surface 11 so that a perpendicular may be made to heating surface 21a, they show and press against drawing 4 by laying the filler 22 of a sheet configuration on heating surface 21a so that it may be located between end-face 10a of an optical fiber 10, and heating surface 21a, and will be in a front condition.
[0038] As the quality of the material of the filler 22 used here, like the example 1 of an operation gestalt, it is desirable to have the same optical property (for it to be the refractive index same at least) as the core of an optical fiber 10 and the same thermal property (for the rate of a heat shrink etc. to be the same), and it is more desirable to consider as a core and this quality of the material.
[0039] Next, a ferrule 13 is dropped and a filler 22 is put between tip periphery 12a and heating surface 21a. While fusing the filler 22 at this time with the heat transfer from heating surface 21a heated by about 160 degrees C, flowing in in the crevice of the irregularity formed in end-face 10a of an optical fiber 10 and filling this, what became excessive is extruded outside from between tip periphery 12a and heating surface 21a, and is set to flash section 22a. Furthermore, if push reliance is advanced, periphery 21b of tip periphery 12a and heating surface 21a agrees,

and these are cutting off flash section 22a as a cutting edge, and it shows and presses against drawing 5 and will be in a condition.
[0040] In case [this] it presses, since the filler 22 which remained in the guide hole 12 has received regulation by the guide hole 12, it can spread no longer in the direction of a path. Thereby, the cross-section configuration does not become large [to breadth] at last like before, but a part for the point of an optical fiber 10 is fabricated by the right circular cylinder configuration where the fixed outer-diameter cross section was maintained. Then, drawing 5's R>'s 5 pressing and maintaining a condition, by stopping heating of heating surface 21a, it solidifies by heat dissipation cooling and the amount of [of an optical fiber 10] point forms the flat side 23 flat-tapped with the apical surface 20 of a ferrule 13 flat and smooth.
[0041] And as shown in drawing 6 , by raising a ferrule 13 above the heating surface 11, flash section 22a is removed and installation is completed. Though flash section 22a had adhered to the ferrule 13 at this time, that adhesion force is performing blasting, such as Ayr, for the same reason, with the above-mentioned example 1 of an operation gestalt having explained, since it is not strong, and is removed simply. In the receptacle which is not illustrated, F07 connector plug after this installation is compared with other optical fibers, and is connected, and it acts as Michimitsu through this connection part, and it is measuring the quantity of light which comes out from the other end, and evaluation of joint loss is performed.
[0042] According to this example 2 of an operation gestalt, the same effectiveness as the above-mentioned example 1 of an operation gestalt can be acquired. Furthermore, since these carry out the duty of the cutting edge which cuts off flash section 22a of a filler 22 by making periphery 21b of heating surface 21a, and tip periphery 12a of the guide hole 12 agree according to this example 2 of an operation gestalt, it becomes possible to remove flash section 22a easily and certainly. Furthermore, since the apical surface 20 of a ferrule 13 does not contact heating surface 21a, flash section 22a is pressed beyond the need, it becomes possible to prevent this becoming easy to stick to the apical surface 20 of a ferrule 13, and it becomes possible to remove flash section 22a from a ferrule 13 easily by blasting of Ayr etc.
[0043] In addition, in the end-face art of the optical fiber of the above-mentioned example 1 of an operation gestalt, and the above-mentioned example 2 of an operation gestalt, although the case where an optical fiber 10 was attached in F07 connector plug was explained to the example, this invention may be applied to the installation to the optical connecter of the type of not only F07 connector plug but others.
[0044] Moreover, although the hole in a ferrule 13 shall be used as the guide hole 12 and it shall fix to F07 connector plug as it is after termination in the above-mentioned example 1 of an operation gestalt, and the above-mentioned example 2 of an operation gestalt, using a ferrule 13 as an optical fiber attaching part The fixture (not shown) which has not only this but the guide hole 10 is prepared, and it uses instead of a ferrule 13 by making this into an optical fiber attaching part. Like the above-mentioned example 1 of an operation gestalt, and the above-mentioned example 2 of an operation gestalt Termination of the optical fiber 10 may be inserted and carried out into the guide hole 12, it may draw out out of the guide hole 12 after termination, and the termination approach of the two-step type which inserts this in an optical connecter etc. and is fixed may be adopted.
[0045] Moreover, in the above-mentioned example 1 of an operation gestalt, although the filler 14 of a bead configuration was used, the filler 22 of a sheet configuration etc. may use the thing of other configurations. Moreover, conversely, in the above-mentioned example 2 of an operation gestalt, although the filler 22 of a sheet configuration was used, the filler 14 of a bead configuration etc. may use the thing of other configurations.
[0046] Moreover, although the heating surface 11 of the above-mentioned example 1 of an operation gestalt was flat, as shown in the above-mentioned example 2 of an operation gestalt, the circular end face of the cylindrical shape-like projection 21 may be adopted as heating surface 21a. Moreover, conversely, in the above-mentioned example 2 of an operation gestalt, although the upper limit side of the cylindrical shape-like projection 21 was used as heating surface 21a, a flat heating surface 11 not only like this but the above-mentioned example 1 of an operation gestalt may be used.

[0047] Moreover, although what has the taper side 15 was used for a part for the point as a ferrule 13 in the above-mentioned example 1 of an operation gestalt, what has the apical surface 20 with a flat hollow circle configuration as shown not only in this but in the above-mentioned example 2 of an operation gestalt may be used. Moreover, although what has the apical surface 20 with a flat hollow circle configuration was conversely used for a part for the point as a ferrule 13 in the above-mentioned example 2 of an operation gestalt, what has not only this but the taper side 15 may be used.

[0048]

[Effect of the Invention] Since according to the end-face art of the optical fiber of this invention according to claim 1 this insufficient part is filled with a filler and fabricated by carrying out melting of the filler which has the core and the rate of the isometropia of an optical fiber, and being filled up with the insufficient part of the end face of an optical fiber flat and smooth, trouble is not caused to optical transmission capacity and it becomes possible to abolish the need of adjusting the ejection die length at the tip of an optical fiber like before.

[0049] Moreover, since it becomes a sharp point by tapering off and making the point of a ferrule into the taper side configuration of a configuration according to the end-face art of an optical fiber according to claim 2, it becomes possible to cut easily and certainly the excessive amount of fillers overflowing from between a tip periphery and heating surfaces. Furthermore, the filler protruded since this taper side did not contact a heating surface is pressed beyond the need, it also becomes possible to prevent this becoming easy to stick to a ferrule point, and it becomes possible [removing the flash section of a filler from a ferrule easily by blasting of Ayr etc.].

[0050] Moreover, since these carry out the duty of the cutting edge which cuts off the flash section of a filler by using the circular end face of a pillar-shaped object as a heating surface, and making the periphery of this heating surface, and the tip periphery of a guide hole agree according to the end-face art of an optical fiber according to claim 3, it becomes possible to remove the flash section of a filler easily and certainly. Furthermore, the filler protruded since the apical surface of a ferrule did not contact a heating surface is pressed beyond the need, it also becomes possible to prevent this becoming easy to stick to the apical surface of a ferrule, and it becomes possible [removing the flash section of a filler from a ferrule easily by blasting of Ayr etc.].

[0051] Moreover, since optical properties, such as a refractive index in the part into which the filler was filled up with making the quality of the material of a filler into the same quality of the material as the core of an optical fiber, become the same as the core of an optical fiber body according to the end-face art of an optical fiber according to claim 4, optical transmission capacity is not reduced. Furthermore, since thermal properties, such as a rate of a heat shrink in the part with which the filler was filled up, also become the same as the core of an optical fiber body, it also becomes possible to prevent fault, such as to separate and to fall from the end face of an optical fiber after cooling.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the end-face art of the optical fiber made from plastics used for optical transmission.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] The optical fiber made from plastics covers with the low clad made of fluorination methacrylic resin of a refractive index the core which consists of fiber, such as methacrylic resin, rather than this core, and is used as a light guide for optical transmission etc. On the occasion of application to the optical transmission of this kind of optical fiber, it is required that that end face should be processed as flat and smooth as possible. That is, since the light transmitted as finishing of this end face is coarse starts scattered reflection and produces optical loss, in order to stop this as much as possible, there is the need of finishing flat and smooth.

[0003] There are a polish approach graduated by grinding an end face as main things of such an approach of finishing, for example, a free cut approach graduated by cutting an end face, a hot plate approach which graduates an end face by pressing against a smooth heating surface. Although the polish approach has the advantage in which the smooth side of a high precision is acquired, it also has the demerit in which processing takes time amount. Moreover, although it has the advantage in which a free cut approach can be processed in a short time, it also has the demerit in which the smooth nature of a processing side is low.

[0004] The hot plate approach has the outstanding features that the end face of a precision higher than a free cut approach can be processed rather than a polish approach in a short time, to these. The detail of the end-face art of the conventional optical fiber by this hot plate approach is explained to below in connection of the optical cable to F07 connector plug, referring to a drawing for an example.

[0005] As shown in drawing 7 , optical fiber 2b is first changed into an unreserved condition partially by stripping off jacket 2a of an optical cable 2 by predetermined die length (for example, about 7mm) using a stripper 1. And after inserting optical fiber 2b into insertion hole 3a currently formed in F07 connector plug 3 so that only a predetermined die-length dimension (for example, about 0.3mm) may project from the tip of a ferrule 4, a stopper 5 is pressed fit in stopper installation section 3b of this F07 connector plug 3. Since jacket 2a in F07 connector plug 3 is put between F07 connector plug 3 and a stopper 5 by this press fit, an optical cable 2 will be fixed to F07 connector plug 3 improper [an extraction] by it.

[0006] Thus, end-face processing is made by the hot plate heater 6 which shows optical fiber 2b of the optical cable 2 attached in F07 connector plug 3 to drawing 8 . That is, heating surface 6a is prepared, this is heated at about 160 degrees C, and optical fiber 2b is pressed against the hot plate heater 6 the F07 whole connector plug 3 for [for / 5 seconds / -] 10 seconds perpendicularly [here]. It presses, and drawing 9 is front optical fiber 2b, and is in the condition of having projected only about 0.3mm from the tip of a ferrule 4, as [mentioned / above]. In addition, although F07 connector plug 3 of this explanation has the ferrule 4 of a pair, in drawing 9 and drawing 10 which are explained below, it illustrates optical fiber 2b in ferrule 4 of one of the two, and continues explanation.

[0007] As shown in drawing 9 , guide hole 4a which is the cylindrical shape-like space where optical fiber 2b is inserted in a ferrule 4, and taper hole 4b which is the space of the truncated-cone configuration opened toward the tip of a ferrule 4 from the lower limit of this guide hole 4a are formed. Moreover, although the gap space 7 is formed between taper hole 4b and optical

fiber 2b, the volume of this gap space 7 has come to spread the volume for a lobe of optical fiber 2b, abbreviation, etc.

[0008] Since the volume of the gap space 7 and the volume for said lobe spread abbreviation etc. and it is carried out as drawing 10 pressed, and it is inner optical fiber 2b and being mentioned above, the amount of said lobe carries out melting deformation with the heat transfer from heating surface 6a so that the gap space 7 may be filled. Thus, while the amount of [of fabricated optical fiber 2b] point becomes a breadth configuration the end corresponding to the configuration of taper hole 4b, the apical surface 2c is evenly fabricated by sticking to smooth heating surface 6a.

[0009] Then, drawing 10's pressing and maintaining a condition, by stopping heating of heating surface 6a, it is cooled and solidified, with smooth apical surface 2c maintained, and end-face processing completes a part for the point of optical fiber 2b. In addition, although what has spot facing hole 4c shown in drawing 11 instead of taper hole 4b is put in practical use, in order to miss that into which it melted for the lobe [optical fiber 2b] like [this] the ferrule 4 of drawing 10 , spot facing hole 4c is prepared.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] Since according to the end-face art of the optical fiber of this invention according to claim 1 this insufficient part is filled with a filler and fabricated by carrying out melting of the filler which has the core and the rate of the isometropia of an optical fiber, and being filled up with the insufficient part of the end face of an optical fiber flat and smooth, trouble is not caused to optical transmission capacity and it becomes possible to abolish the need of adjusting the ejection die length at the tip of an optical fiber like before.
[0049] Moreover, since it becomes a sharp point by tapering off and making the point of a ferrule into the taper side configuration of a configuration according to the end-face art of an optical fiber according to claim 2, it becomes possible to cut easily and certainly the excessive amount of fillers overflowing from between a tip periphery and heating surfaces. Furthermore, the filler protruded since this taper side did not contact a heating surface is pressed beyond the need, it also becomes possible to prevent this becoming easy to stick to a ferrule point, and it becomes possible [removing the flash section of a filler from a ferrule easily by blasting of Ayr etc.].
[0050] Moreover, since these carry out the duty of the cutting edge which cuts off the flash section of a filler by using the circular end face of a pillar-shaped object as a heating surface, and making the periphery of this heating surface, and the tip periphery of a guide hole agree according to the end-face art of an optical fiber according to claim 3, it becomes possible to remove the flash section of a filler easily and certainly. Furthermore, the filler protruded since the apical surface of a ferrule did not contact a heating surface is pressed beyond the need, it also becomes possible to prevent this becoming easy to stick to the apical surface of a ferrule, and it becomes possible [removing the flash section of a filler from a ferrule easily by blasting of Ayr etc.].
[0051] Moreover, since optical properties, such as a refractive index in the part into which the filler was filled up with making the quality of the material of a filler into the same quality of the material as the core of an optical fiber, become the same as the core of an optical fiber body according to the end-face art of an optical fiber according to claim 4, optical transmission capacity is not reduced. Furthermore, since thermal properties, such as a rate of a heat shrink in the part with which the filler was filled up, also become the same as the core of an optical fiber body, it also becomes possible to prevent fault, such as to separate and to fall from the end face of an optical fiber after cooling.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, in the end-face art of the conventional optical fiber by the hot plate approach of the above-mentioned explanation, it had the problem explained below. Namely, although taper hole 4b and spot facing hole 4c are prepared in the ferrule 4 in order to avoid facing carrying out melting of the tip and obtaining smooth apical surface 2c, and that into which it melted for said lobe flowing in between the apical surface of a ferrule 4, and heating surface 6a, and becoming weld flash Consequently, the amount of [of optical fiber 2b] point becomes the tip configuration where the path as shown in drawing 10 or drawing 11 spread.
[0011] If such optical fiber 2b is use into an optical transmission path , since joint loss will become large by considering the configuration for said point as a cause , when using it , for example for the large optical fiber for a communication link of a band , it is optimal that making as small as possible dimension **h of the ferrule 4 show in drawing 10 and drawing 11 in order to reduce the effect as much as possible sets to dimension **h**0 desirable still more preferably . However, although it is required that the ejection die length for a lobe of optical fiber 2b should be controlled to a very short thing according to this in order to make this dimension **h small When exact control of such a very small dimension is difficult and ejection die length is too long, overflow into the apical surface of a ferrule 4, adhere, or Or when ejection die length is too short, the problem of being unable to form smooth apical surface 2c, without the ability fully sticking to heating surface 6a will arise.
[0012] Moreover, in order to avoid such a problem, when it is going to secure a certain amount of dimension **h, a clad mixes in the core of return and optical fiber 2b so that the fusion part of optical fiber 2b which escaped to the gap space 7 other than the problem of the above-mentioned joint loss may concentrate toward an axis again, and there is a possibility of causing the further trouble to optical transmission capacity.
[0013] This invention is made in view of the above-mentioned situation, in end-face processing of an optical fiber, does not cause trouble to optical transmission capacity, and aims at offer of the end-face art of an optical fiber without the need of controlling the ejection die length at the tip of an optical fiber like before.
[0014]

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] The following means were used for the end-face art of the optical fiber of this invention in order to solve the above-mentioned technical problem. Namely, the end-face art of an optical fiber according to claim 1 In the end-face art of an optical fiber which makes the end face of an optical fiber graduate using a smooth heating surface Between the process which inserts said optical fiber into the guide hole which is the cylindrical shape-like space formed in the optical fiber attaching part, and holds it at right angles to said heating surface, and said end face and said heating surface It is characterized by pressing the tip periphery formed at the tip by the side of the core of said optical fiber, the process which arranges the filler which has a rate of the isometropia, and said heating surface of said optical fiber attaching part so that it may be made to stick to said heating surface, and having the process which carries out joining of said filler to said end face.
[0015] According to the end-face art of the optical fiber of the claim 1 above-mentioned publication, first, while inserting an optical fiber and fixing in a guide hole, a filler is arranged so that it may be located between the end face of an optical fiber, and a heating surface. Then, a filler is put between the end face of an optical fiber, and a heating surface by turning and pressing the tip periphery of a guide hole against a heating surface. The filler at this time is fused with the heat transfer from a heating surface, and it is fabricated by deforming into the configuration stuck to a smooth heating surface flat and smooth while it flows in in the crevice of the irregularity formed in the end face and fills this.
[0016] The end-face art of an optical fiber according to claim 2 is characterized by forming the taper side where said guide hole is formed in the interior of a ferrule at the same axle, and is tapering off toward said tip periphery at the tip periphery section of this ferrule, using a ferrule as said optical fiber attaching part in the end-face art of an optical fiber according to claim 1.
[0017] According to the end-face art of the optical fiber of the claim 2 above-mentioned publication, it becomes a sharp point by making the point of a ferrule into the taper side of a configuration [taper / off] toward a tip periphery.
[0018] the end-face art of an optical fiber according to claim 3 — the end-face art of an optical fiber according to claim 1 or 2 — setting — the inside diameter of said guide hole, and abbreviation — it is characterized by using said circular end face of the pillar-shaped object which has the circular end face of the same outer-diameter dimension as a heating surface.
[0019] According to the end-face art of the optical fiber of the claim 3 above-mentioned publication, in case an optical fiber presses, these carry out the duty of the cutting edge which cuts off the flash part of a filler by making the periphery of a circular end face, and the tip periphery of a guide hole agree. Furthermore, since the apical surface of a ferrule does not contact a heating surface, a filler is pressed beyond the need and this becomes easy to stick to the apical surface of a ferrule.
[0020] The end-face art of an optical fiber according to claim 4 is characterized by said filler being said core and this quality of the material in the end-face art of an optical fiber given in either of claims 1-3.
[0021] According to the end-face art of the optical fiber of the claim 4 above-mentioned publication, the optical properties that the filler was filled up with making the quality of the

material of a filler into the same quality of the material as the core of an optical fiber, such as a refractive index of a part, and thermal properties, such as a rate of a heat shrink, become the same as the core of an optical fiber body.
[0022]
[Embodiment of the Invention] Although the end-face art of the optical fiber of this invention presses the end face of an optical fiber against a smooth heating surface, makes it graduate, and it explains each of that example of an operation gestalt below, referring to a drawing, it is needless to say that this invention is not that by which a limited interpretation is carried out at them. In addition, also in each example of an operation gestalt, the case where an optical fiber is attached in F07 connector plug shall be explained to an example.
[0023] [Example 1 of an operation gestalt] The example 1 of an operation gestalt is explained first, referring to drawing 1 - drawing 3 . The process which strips off jacket 2a of an optical cable 2, and changes optical fiber 2b into an unreserved condition partially is the same as that of what was explained by the Prior art.
[0024] In this example 1 of an operation gestalt, an optical fiber 10 is inserted into the ferrule 13 (optical fiber attaching part) by which the guide hole 12 which is cylindrical shape-like space was formed in the interior in the shape of the same axle. Between the process held at right angles to the heating surface 11 of a hot plate heater, and end-face 10a of an optical fiber 10 and a heating surface 11 The core of an optical fiber 10, and the process which arranges the filler 14 which has a rate of the isometropia, While tip periphery 12a formed at the tip (tip which turned to the heating surface 11 side of said optical fiber attaching part) of the guide hole 12 is pressed so that it may be made to stick to a heating surface 11, and carrying out joining of the filler 14 to end-face 10a As compared with the former, it differs in that it has the process which cuts out from between tip periphery 12a and heating surfaces 11 flash section 14a of the filler 14 extruded outside by tip periphery 12a.
[0025] Furthermore, in this example 1 of an operation gestalt, it differs from the ferrule 4 explained by the Prior art in that the taper side 15 which is tapering off toward tip periphery 12a at the tip periphery section of a ferrule 13 is formed. When it sees as this taper side 15 in the cross section (cross section shown in drawing 1) which passes along the axis of a ferrule 13, the include angle alpha with a virtual flat surface perpendicular to said axis to make Although suitably set up from the range of zero < alpha< 90 degrees in consideration of the detachability of the difficulty of manufacture of a ferrule point, and the flash section of a filler, the configuration of the receptacle combined with a ferrule, etc., since manufacture is easy, it is desirable that it is the range which is ten - 60 degrees.
[0026] If detailed explanation is given to below, after inserting an optical fiber 10 in the same axle and bringing the end-face 10a close as much as possible into the guide hole 12 first at tip periphery 12a, the jacket which covers an optical fiber 10 with a caulking etc. and which is not illustrated is fixed to F07 connector plug improper [an extraction]. Then, while a ferrule 13 and the guide hole 12 hold a ferrule 13 above the heating surface 11 so that a perpendicular may be made to a heating surface 11, they show and press against drawing 1 by laying a filler 14 on a heating surface 11 so that it may be located between end-face 10a of an optical fiber 10, and a heating surface 11, and will be in a front condition.
[0027] As for the filler 14 used here, it is desirable to have a bead configuration and to have the same optical property (a refractive index to be the same at least) as the core of an optical fiber 10 and the same thermal property (for the rate of a heat shrink etc. to be the same) as the quality of the material, and it is more desirable to consider as a core and this quality of the material.
[0028] Next, a ferrule 13 is dropped with the perpendicular condition over a heating surface 11 maintained, and a filler 14 is put between tip periphery 12a and a heating surface 11. While fusing the filler 14 at this time with the heat transfer from the heating surface 11 heated by about 160 degrees C, flowing in in the crevice of the irregularity formed in end-face 10a of an optical fiber 10 and filling this, what became excessive is extruded outside from between tip periphery 12a and heating surfaces 11, and is set to flash section 14a.
[0029] Furthermore, while tip periphery 12a will contact a heating surface 11 closely and flash

partial 14a will be divided from optical fiber 10 body as shown in drawing 2 if push reliance is advanced, the field adjacent to the heating surface 11 of a filler 14 sticks to the smooth heating surface 11, and end-face processing is carried out flat and smooth.

[0030] Even if the filler 14 with which it filled up in the guide hole 12 at this time of pressing tends to spread in the direction of a path of an optical fiber 10, since it has received regulation by the guide hole 12, it can spread no longer. Thereby, the cross-section configuration does not become large [to breadth] at last like before, but a part for the point of an optical fiber 10 is fabricated by the right circular cylinder configuration where the fixed outer-diameter cross section was maintained. Then, by stopping heating of a heating surface 11, drawing 2's pressing and maintaining a condition, a filler 14 is solidified by heat dissipation cooling, it is smooth and the flat side 16 which makes a periphery tip periphery 12a of a ferrule 13 is formed. At this time, flash section 14a is also solidified to coincidence.

[0031] And as shown in drawing 3 , by raising a ferrule 13 above the heating surface 11, flash section 14a is removed and installation is completed. Even if flash section 14a adheres to a ferrule 13 at this time, since that adhesion force is not strong, it is simply removed by blasting of Ayr etc. by the reason mentioned later. In the receptacle which is not illustrated, F07 connector plug after this installation is compared with other optical fibers, and is connected, and it acts as Michimitsu through this connection part, and it is measuring the quantity of light which comes out from the other end, and evaluation of joint loss is performed.

[0032] Since according to the end-face art of the optical fiber of this example 1 of an operation gestalt said insufficient part is filled with a filler 14 and fabricated by carrying out melting of the filler 14 which has the core and the rate of the isometropia of an optical fiber 10, and being filled up with the insufficient part of end-face 10a of an optical fiber 10 flat and smooth, it is not necessary to cause trouble to optical transmission capacity and to control the ejection die length at the tip of an optical fiber 10 like before.

[0033] Moreover, since it becomes a sharp point by making the tip periphery section of a ferrule 13 into the taper side 15 of the tapering configuration which goes to tip periphery 12a according to the end-face art of the optical fiber of this example 1 of an operation gestalt, it becomes possible by making a heating surface 11 contact tip periphery 12a to cut overflowing excessive flash section 14a easily and certainly. Furthermore, since this taper side 15 does not contact a heating surface 11, flash section 14a is pressed beyond the need, it becomes possible to prevent this becoming easy to stick to the point of a ferrule 13, and it becomes possible to remove flash section 14a from a ferrule 13 easily by blasting of Ayr etc.

[0034] Moreover, since the optical properties of the part into which the filler 14 was filled up with making the quality of the material of a filler 14 the same as the quality of the material of the core of an optical fiber 10, such as a refractive index, become the same as the core of an optical fiber 10 according to the end-face art of the optical fiber of this example 1 of an operation gestalt, optical transmission capacity is not reduced. Furthermore, since the thermal properties of the part with which the filler 14 was filled up, such as a rate of a heat shrink, also become the same as the core of an optical fiber 10, it also becomes possible to prevent fault, such as to separate and to fall from end-face 10a after cooling.

[0035] The example 2 of an operation gestalt of this invention is explained to below, referring to the [example 2 of an operation gestalt] next drawing 4 - drawing 6 . In addition, in this example 2 of an operation gestalt, the same sign is given to the same component as what was explained by drawing 1 of the above-mentioned example 1 of an operation gestalt - drawing 3 , and the explanation is omitted.

[0036] The point that not the taper side 15 but the apical surface 20 of a hollow circle configuration is formed in a part for the point of a ferrule 13 in this example 2 of an operation gestalt as compared with the above-mentioned example 1 of an operation gestalt, the inside diameter d1 (for example, 1 millimeter) of the guide hole 12, and abbreviation — with the point that the cylindrical shape-like projection (pillar-shaped object) 21 which makes circular heating surface 21a of the same outer-diameter dimension d2 (for example, 1 millimeter) an upper limit side is formed The points which have adopted the filler 22 of a sheet configuration (100 micrometers in for example, thickness) differ.

[0037] First, an optical fiber 10 is inserted into the guide hole 12, and ten is fixed toFoptical fiber 07 connector plug improper [an extraction] by a caulking etc. Then, while a ferrule 10 and the guide hole 12 hold a ferrule 13 above the heating surface 11 so that a perpendicular may be made to heating surface 21a, they show and press against drawing 4 by laying the filler 22 of a sheet configuration on heating surface 21a so that it may be located between end-face 10a of an optical fiber 10, and heating surface 21a, and will be in a front condition.
[0038] As the quality of the material of the filler 22 used here, like the example 1 of an operation gestalt, it is desirable to have the same optical property (for it to be the refractive index same at least) as the core of an optical fiber 10 and the same thermal property (for the rate of a heat shrink etc. to be the same), and it is more desirable to consider as a core and this quality of the material.
[0039] Next, a ferrule 13 is dropped and a filler 22 is put between tip periphery 12a and heating surface 21a. While fusing the filler 22 at this time with the heat transfer from heating surface 21a heated by about 160 degrees C, flowing in in the crevice of the irregularity formed in end-face 10a of an optical fiber 10 and filling this, what became excessive is extruded outside from between tip periphery 12a and heating surface 21a, and is set to flash section 22a. Furthermore, if push reliance is advanced, periphery 21b of tip periphery 12a and heating surface 21a agrees, and these are cutting off flash section 22a as a cutting edge, and it shows and presses against drawing 5 and will be in a condition.
[0040] In case [this] it presses, since the filler 22 which remained in the guide hole 12 has received regulation by the guide hole 12, it can spread no longer in the direction of a path. Thereby, the cross-section configuration does not become large [to breadth] at last like before, but a part for the point of an optical fiber 10 is fabricated by the right circular cylinder configuration where the fixed outer-diameter cross section was maintained. Then, drawing 5's R>'s 5 pressing and maintaining a condition, by stopping heating of heating surface 21a, it solidifies by heat dissipation cooling and the amount of [of an optical fiber 10] point forms the flat side 23 flat-tapped with the apical surface 20 of a ferrule 13 flat and smooth.
[0041] And as shown in drawing 6 , by raising a ferrule 13 above the heating surface 11, flash section 22a is removed and installation is completed. Though flash section 22a had adhered to the ferrule 13 at this time, that adhesion force is performing blasting, such as Ayr, for the same reason, with the above-mentioned example 1 of an operation gestalt having explained, since it is not strong, and is removed simply. In the receptacle which is not illustrated, F07 connector plug after this installation is compared with other optical fibers, and is connected, and it acts as Michimitsu through this connection part, and it is measuring the quantity of light which comes out from the other end, and evaluation of joint loss is performed.
[0042] According to this example 2 of an operation gestalt, the same effectiveness as the above-mentioned example 1 of an operation gestalt can be acquired. Furthermore, since these carry out the duty of the cutting edge which cuts off flash section 22a of a filler 22 by making periphery 21b of heating surface 21a, and tip periphery 12a of the guide hole 12 agree according to this example 2 of an operation gestalt, it becomes possible to remove flash section 22a easily and certainly. Furthermore, since the apical surface 20 of a ferrule 13 does not contact heating surface 21a, flash section 22a is pressed beyond the need, it becomes possible to prevent this becoming easy to stick to the apical surface 20 of a ferrule 13, and it becomes possible to remove flash section 22a from a ferrule 13 easily by blasting of Ayr etc.
[0043] In addition, in the end-face art of the optical fiber of the above-mentioned example 1 of an operation gestalt, and the above-mentioned example 2 of an operation gestalt, although the case where an optical fiber 10 was attached in F07 connector plug was explained to the example, this invention may be applied to the installation to the optical connecter of the type of not only F07 connector plug but others.
[0044] Moreover, although the hole in a ferrule 13 shall be used as the guide hole 12 and it shall fix to F07 connector plug as it is after termination in the above-mentioned example 1 of an operation gestalt, and the above-mentioned example 2 of an operation gestalt, using a ferrule 13 as an optical fiber attaching part The fixture (not shown) which has not only this but the guide hole 10 is prepared, and it uses instead of a ferrule 13 by making this into an optical fiber

attaching part. Like the above-mentioned example 1 of an operation gestalt, and the above-mentioned example 2 of an operation gestalt Termination of the optical fiber 10 may be inserted and carried out into the guide hole 12, it may draw out out of the guide hole 12 after termination, and the termination approach of the two-step type which inserts this in an optical connecter etc. and is fixed may be adopted.

[0045] Moreover, in the above-mentioned example 1 of an operation gestalt, although the filler 14 of a bead configuration was used, the filler 22 of a sheet configuration etc. may use the thing of other configurations. Moreover, conversely, in the above-mentioned example 2 of an operation gestalt, although the filler 22 of a sheet configuration was used, the filler 14 of a bead configuration etc. may use the thing of other configurations.

[0046] Moreover, although the heating surface 11 of the above-mentioned example 1 of an operation gestalt was flat, as shown in the above-mentioned example 2 of an operation gestalt, the circular end face of the cylindrical shape-like projection 21 may be adopted as heating surface 21a. Moreover, conversely, in the above-mentioned example 2 of an operation gestalt, although the upper limit side of the cylindrical shape-like projection 21 was used as heating surface 21a, a flat heating surface 11 not only like this but the above-mentioned example 1 of an operation gestalt may be used.

[0047] Moreover, although what has the taper side 15 was used for a part for the point as a ferrule 13 in the above-mentioned example 1 of an operation gestalt, what has the apical surface 20 with a flat hollow circle configuration as shown not only in this but in the above-mentioned example 2 of an operation gestalt may be used. Moreover, although what has the apical surface 20 with a flat hollow circle configuration was conversely used for a part for the point as a ferrule 13 in the above-mentioned example 2 of an operation gestalt, what has not only this but the taper side 15 may be used.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the process of the example 1 of an operation gestalt of the end-face art of the optical fiber of this invention, and is a sectional side elevation.
[Drawing 2] It is drawing showing the next process of the end-face art of this optical fiber, and is a sectional side elevation.
[Drawing 3] It is drawing showing the next process of the end-face art of this optical fiber, and is a sectional side elevation.
[Drawing 4] It is drawing showing the process of the example 2 of an operation gestalt of the end-face art of the optical fiber of this invention, and is a sectional side elevation.
[Drawing 5] It is drawing showing the next process of the end-face art of this optical fiber, and is a sectional side elevation.
[Drawing 6] It is drawing showing the next process of the end-face art of this optical fiber, and is a sectional side elevation.
[Drawing 7] It is drawing showing the process of the end-face art of the conventional optical fiber, and is a perspective view.
[Drawing 8] It is drawing showing the next process of the end-face art of this optical fiber, and is a perspective view.
[Drawing 9] It is drawing showing the next process of the end-face art of this optical fiber, and is a sectional side elevation.
[Drawing 10] It is drawing showing the next process of the end-face art of this optical fiber, and is a sectional side elevation.
[Drawing 11] It is drawing showing the modification of the end-face art of this optical fiber, and is a sectional side elevation.
[Description of Notations]
10 ... Optical fiber
10a ... End face
11 ... Heating surface
12 ... Guide hole
14 22 ... Filler
12a ... Tip periphery
13 ... A ferrule, optical fiber attaching part
15 ... Taper side
d1 ... Inside diameter
d2 ... Outer-diameter dimension
21a ... Circular end face (heating surface)
21 ... Cylindrical shape-like projection (pillar-shaped object)

[Translation done.]

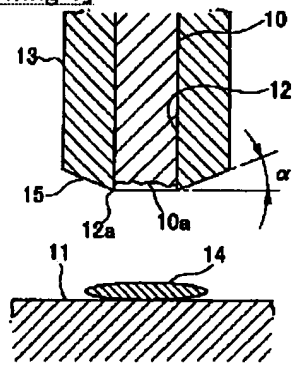
* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

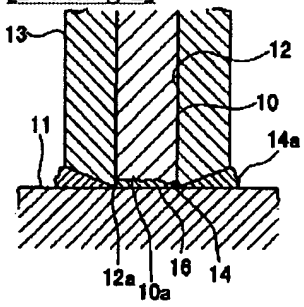
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

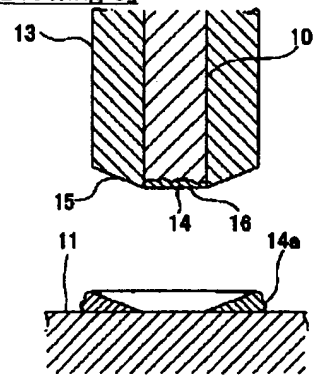
[Drawing 1]



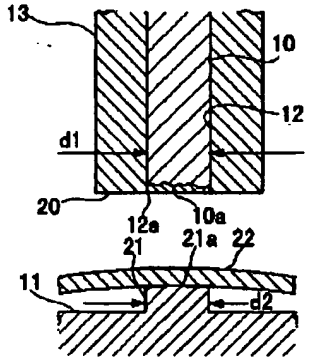
[Drawing 2]



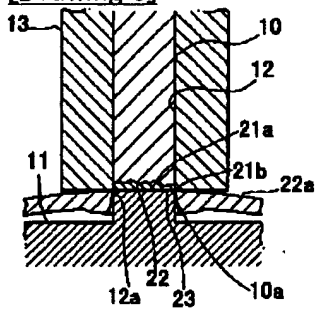
[Drawing 3]



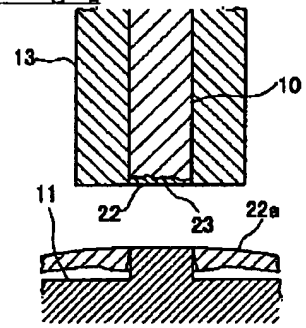
[Drawing 4]



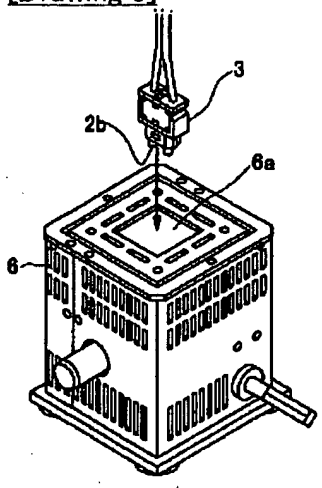
[Drawing 5]



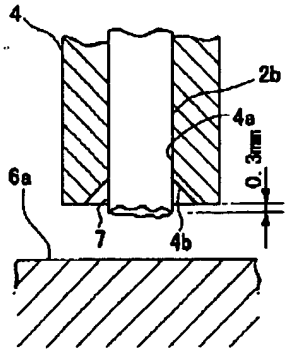
[Drawing 6]



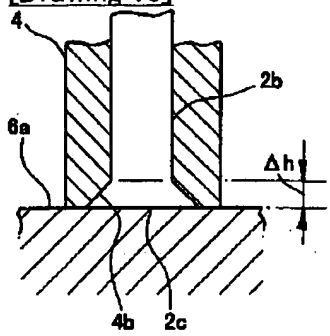
[Drawing 8]



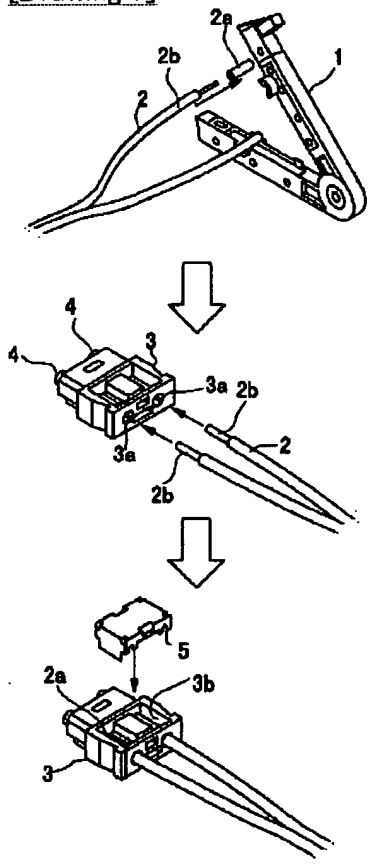
[Drawing 9]



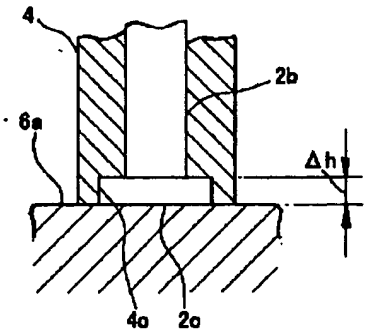
[Drawing 10]



[Drawing 7]



[Drawing 11]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（A）　(11)特許出願公開番号
特開2000－298224
（P2000－298224A）
(43)公開日　平成12年10月24日(2000.10.24)

(51)Int.Cl.'	識別記号	FI		テーマコード'(参考)
G02B 6/36		G02B 6/36		2H036
6/10		6/10	D	2H050

審査請求　未請求　請求項の数4　OL　（全 8 頁）

(21)出願番号　特願平11－105908

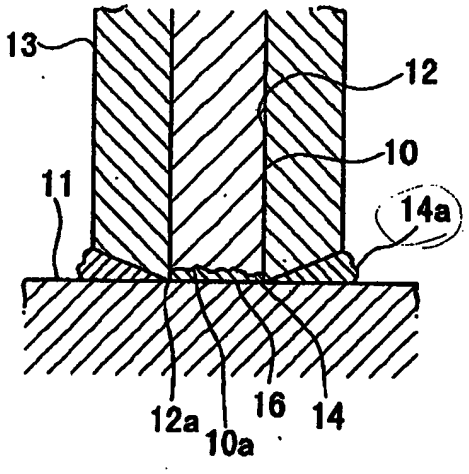
(22)出願日　平成11年4月13日(1999.4.13)

(71)出願人　000006035
三菱レイヨン株式会社
東京都港区港南一丁目6番41号
(72)発明者　石川　館一
愛知県豊橋市牛川通四丁目1番地の2　三菱レイヨン株式会社豊橋事業所内
(72)発明者　渡辺　康
愛知県豊橋市牛川通四丁目1番地の2　三菱レイヨン株式会社豊橋事業所内
(74)代理人　100064908
弁理士　志賀　正武　（外8名）

最終頁に続く

(54)【発明の名称】　光ファイバの端面処理方法

(57)【要約】
【課題】　光伝送能力に支障を来すことがなく、かつ従来のように光ファイバの先端の突き出し長さを制御する必要のない光ファイバの端面処理方法の提供を課題とする。
【解決手段】　光ファイバ１０を、光ファイバ保持部であるフェルール１３内に形成された円柱形状空間であるガイド孔１２内に挿入して加熱面１１に垂直に保持する工程と、端面１０ａと加熱面１１との間に、光ファイバ１０のコアと同屈折率を有する充填材１４を配置する工程と、フェルール１３内の加熱面１１側の先端に形成された先端周縁１２ａを、加熱面１１に密着させるように押し当てて、充填材１４を端面１０ａに溶着させる工程とを有する方法を採用した。



1

【特許請求の範囲】
【請求項１】　光ファイバの端面を平滑な加熱面を用いて平滑化させる光ファイバの端面処理方法において、
前記光ファイバを、光ファイバ保持部内に形成された円柱形状空間であるガイド孔内に挿入して前記加熱面に垂直に保持する工程と、
前記端面と前記加熱面との間に、前記光ファイバのコアと同屈折率を有する充填材を配置する工程と、
前記光ファイバ保持部の前記加熱面側の先端に形成された先端周縁を、前記加熱面に密着させるように押し当てて、前記充填材を前記端面に溶着させる工程とを有することを特徴とする光ファイバの端面処理方法。
【請求項２】　請求項１記載の光ファイバの端面処理方法において、
前記光ファイバ保持部としてフェルールを用い、
前記ガイド孔は、フェルール内部に同軸に形成されており、
該フェルールの先端外周部には、前記先端周縁に向かって先細りとなるテーパ面が形成されていることを特徴とする光ファイバの端面処理方法。
【請求項３】　請求項１又は２記載の光ファイバの端面処理方法において、
前記ガイド孔の内径寸法と略同じ外径寸法の円形端面を有する柱状体の前記円形端面を加熱面として用いることを特徴とする光ファイバの端面処理方法。
【請求項４】　請求項１から３のいずれかに記載の光ファイバの端面処理方法において、
前記充填材は、前記コアと同材質であることを特徴とする光ファイバの端面処理方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、光伝送に使用されるプラスチック製の光ファイバの端面処理方法に関するものである。
【０００２】
【従来の技術】プラスチック製の光ファイバは、例えば、メタクリル樹脂等の繊維からなるコアを、該コアよりも屈折率の低いフッ素化メタクリル樹脂製のクラッドで被覆したものであり、光伝送のためのライトガイド等として利用されている。この種の光ファイバの光伝送への適用に際しては、その端面を出来るだけ平滑に処理することが要求される。すなわち、この端面の仕上げが粗雑であると、伝送される光が乱反射を起こして光学的損失を生じるので、これを極力抑えるために、平滑に仕上げる必要が有るのである。
【０００３】このような仕上げ方法の主なものとしては、例えば、端面を研磨することで平滑化する研磨処理法や、端面を切断することで平滑化するフリーカット処理法や、端面を平滑な加熱面に押し当てることで平滑化するホットプレート処理法などがある。研磨処理法は、

2

高い精度の平滑面が得られるという長所を有しているが、処理に時間がかかるという短所も有している。また、フリーカット処理法は、短時間で処理を行えるという長所を有しているが、処理面の平滑性が低いという短所も有している。
【０００４】これらに対し、ホットプレート処理法は、フリーカット処理法よりも高い精度の端面を、研磨処理法よりも短時間で処理できるという優れた特長を有している。このホットプレート処理法による、従来の光ファイバの端面処理方法の詳細について、Ｆ０７コネクタプラグへの光ケーブルの接続を例に、図面を参照しながら以下に説明を行う。
【０００５】図７に示すように、まず、ストリッパー１を用いて光ケーブル２のジャケット２ａを所定長さ分（例えば約７ｍｍ）だけ剥ぎ取ることで、光ファイバ２ｂを部分的に剥き出しの状態にする。そして、Ｆ０７コネクタプラグ３に形成されている挿入孔３ａ内に、所定長さ寸法（例えば約０．３ｍｍ）だけフェルール４の先端から突出するように光ファイバ２ｂを挿入した後、このＦ０７コネクタプラグ３のストッパ取り付け部３ｂ内にストッパ５を圧入する。この圧入により、Ｆ０７コネクタプラグ３内のジャケット２ａは、Ｆ０７コネクタプラグ３とストッパ５との間に挟み込まれるので、光ケーブル２が、抜出不可にＦ０７コネクタプラグ３に固定されることになる。
【０００６】このようにしてＦ０７コネクタプラグ３に取り付けられた光ケーブル２の光ファイバ２ｂは、図８に示すホットプレート加熱器６によって端面処理がなされる。すなわち、ホットプレート加熱器６には、加熱面６ａが設けられており、これを例えば約１６０℃に加熱し、ここに垂直に光ファイバ２ｂを、例えば５秒間～１０秒間の間、Ｆ０７コネクタプラグ３ごと押し当てる。図９が、押し当て前の光ファイバ２ｂであり、前述したように、フェルール４の先端より約０．３ｍｍだけ突出した状態となっている。なお、本説明のＦ０７コネクタプラグ３は、一対のフェルール４を有するものであるが、以下に説明する図９及び図１０では、片方のフェルール４内の光ファイバ２ｂを図示して説明を続ける。
【０００７】図９に示すように、フェルール４には、光ファイバ２ｂが挿通される円柱形状空間であるガイド孔４ａと、該ガイド孔４ａの下端よりフェルール４の先端に向かって開拡する円錐台形状の空間であるテーパ孔４ｂとが形成されている。また、テーパ孔４ｂと光ファイバ２ｂとの間には、間隙空間７が形成されているが、この間隙空間７の容積は、光ファイバ２ｂの突出部分の体積と略等しくなっている。
【０００８】図１０が押し当て中の光ファイバ２ｂであり、上述したように、間隙空間７の容積と前記突出部分の体積は略等しくされているので、前記突出部分は、加熱面６ａからの伝熱により、間隙空間７を満たすように

溶融変形する。このようにして成形された光ファイバ２ｂの先端部分は、テーパ孔４ｂの形状に合致する末広がり形状になるとともに、その先端面２ｃは、平滑な加熱面６ａに密着することで平坦に成形される。

【０００９】この後、図１０の押し当て状態を保ったまま、加熱面６ａの加熱を止めることで、光ファイバ２ｂの先端部分は、平滑な先端面２ｃを維持したまま冷却して固化され、端面処理が完了する。なお、テーパ孔４ｂの代わりに、図１１に示す座ぐり孔４ｃを有するものも実用化されているが、これも図１０のフェルール４と同様に、光ファイバ２ｂの突出部分の溶けたものを逃がすために座ぐり孔４ｃを設けたものである。

【００１０】

【発明が解決しようとする課題】ところで、上記説明のホットプレート処理法による、従来の光ファイバの端面処理方法では、以下に説明する問題を有していた。すなわち、先端を溶融させて平滑な先端面２ｃを得るに際し、前記突出部分の溶けたものが、フェルール４の先端面と加熱面６ａとの間に流れ込んでバリとなってしまうのを避けるために、フェルール４には、テーパ孔４ｂや座ぐり孔４ｃが設けられているのであるが、その結果、光ファイバ２ｂの先端部分は、図１０や図１１に示すような径の広がった先端形状となる。

【００１１】この様な光ファイバ２ｂを光伝送経路中に使用すると、前記先端部分の形状を原因として結合損失が大きくなるので、例えば帯域の広い通信用光ファイバに使用する場合には、その影響を極力低減させるべく、図１０及び図１１に示すフェルール４の寸法△ｈをできるだけ小さくするのが好ましく、さらに好ましくは、寸法△ｈ≒０とするのが最適である。しかし、この寸法△ｈを小さくするためには、これに合わせて光ファイバ２ｂの突出部分の突き出し長さを極めて短いものに制御することが要求されるのであるが、この様な微少寸法の正確な制御は困難であり、突き出し長さが長すぎることによってフェルール４の先端面にはみ出して付着したり、あるいは、突き出し長さが短すぎることによって充分に加熱面６ａに密着できずに平滑な先端面２ｃを形成できないなどの問題が生じることとなる。

【００１２】また、この様な問題を避けるために、ある程度の寸法△ｈを確保しようとすると、上記結合損失の問題の他に、間隙空間７に逃げた光ファイバ２ｂの溶融部分が再び軸芯に向かって集中するように戻り、光ファイバ２ｂのコアにクラッドが混入して、光伝送能力に更なる支障を来す恐れがある。

【００１３】本発明は、上記事情を鑑みてなされたものであって、光ファイバの端面処理において、光伝送能力に支障を来すことがなく、かつ従来のように光ファイバの先端の突き出し長さを制御する必要のない光ファイバの端面処理方法の提供を目的とする。

【００１４】

【課題を解決するための手段】本発明の光ファイバの端面処理方法は、上記課題を解決するために以下の手段を採用した。すなわち請求項１記載の光ファイバの端面処理方法は、光ファイバの端面を平滑な加熱面を用いて平滑化させる光ファイバの端面処理方法において、前記光ファイバを、光ファイバ保持部内に形成された円柱形状空間であるガイド孔内に挿入して前記加熱面に垂直に保持する工程と、前記端面と前記加熱面との間に、前記光ファイバのコアと同屈折率を有する充填材を配置する工程と、前記光ファイバ保持部の前記加熱面側の先端に形成された先端周縁を、前記加熱面に密着させるように押し当てて、前記充填材を前記端面に溶着させる工程とを有することを特徴とする。

【００１５】上記請求項１記載の光ファイバの端面処理方法によれば、まず、ガイド孔内に光ファイバを挿入して固定すると共に、充填材を、光ファイバの端面と加熱面との間に位置するように配置させる。その後、ガイド孔の先端周縁を加熱面に向けて押し当てることで、充填材が、光ファイバの端面と加熱面との間に挟み込まれる。このときの充填材は、加熱面からの伝熱により溶融しており、端面に形成された凹凸の凹部内に流れ込んでこれを満たすと共に、平滑な加熱面に密着する形状に変形することで平滑に成形される。

【００１６】請求項２記載の光ファイバの端面処理方法は、請求項１記載の光ファイバの端面処理方法において、前記光ファイバ保持部としてフェルールを用い、前記ガイド孔が、フェルール内部に同軸に形成されており、該フェルールの先端外周部には、前記先端周縁に向かって先細りとなるテーパ面が形成されていることを特徴とする。

【００１７】上記請求項２記載の光ファイバの端面処理方法によれば、フェルールの先端部を先端周縁に向かって先細りな形状のテーパ面とすることで、鋭利な先端部となる。

【００１８】請求項３記載の光ファイバの端面処理方法は、請求項１又は２記載の光ファイバの端面処理方法において、前記ガイド孔の内径寸法と略同じ外径寸法の円形端面を有する柱状体の前記円形端面を加熱面として用いることを特徴とする。

【００１９】上記請求項３記載の光ファイバの端面処理方法によれば、光ファイバの押し当ての際に、円形端面の周縁とガイド孔の先端周縁とを合致させることで、これらが、充填材のはみ出し部分を切り取る刃の役目をする。さらには、フェルールの先端面は加熱面に当接しないので、必要以上に充填材を圧迫してこれがフェルールの先端面に貼り付きやすくなることがない。

【００２０】請求項４記載の光ファイバの端面処理方法は、請求項１から３のいずれかに記載の光ファイバの端面処理方法において、前記充填材が、前記コアと同材質であることを特徴とする。

【００２１】上記請求項４記載の光ファイバの端面処理方法によれば、充填材の材質を光ファイバのコアと同じ材質にすることで、充填材が充填された部分の屈折率等の光学的特性と、熱収縮率等の熱的特性とが、光ファイバ本体のコアと同じになる。

【００２２】

【発明の実施の形態】本発明の光ファイバの端面処理方法は、光ファイバの端面を平滑な加熱面に押し当てて平滑化させるものであり、その各実施形態例を図面を参照しながら以下に説明するが、本発明がそれらに限定解釈されるものでないことはもちろんである。なお、各実施形態例においても、Ｆ０７コネクタプラグに光ファイバを取り付ける場合を例に説明を行うものとする。

【００２３】［実施形態例１］まず、図１～図３を参照しながら、実施形態例１について説明する。光ケーブル２のジャケット２ａを剥ぎ取って光ファイバ２ｂを部分的に剥き出しの状態にする工程までは、従来の技術で説明したものと同様である。

【００２４】本実施形態例１では、光ファイバ１０を、円柱形状空間であるガイド孔１２が内部に同軸状に形成されたフェルール１３（光ファイバ保持部）内に挿入して、ホットプレート加熱器の加熱面１１に垂直に保持する工程と、光ファイバ１０の端面１０ａと加熱面１１との間に、光ファイバ１０のコアと同屈折率を有する充填材１４を配置する工程と、ガイド孔１２の先端（前記光ファイバ保持部の、加熱面１１側を向いた先端）に形成された先端周縁１２ａを、加熱面１１に密着させるように押し当てて、充填材１４を端面１０ａに溶着させると共に、先端周縁１２ａと加熱面１１との間から外部に押し出された充填材１４のはみ出し部１４ａを、先端周縁１２ａで切り取る工程とを有する点が従来と比較して異なっている。

【００２５】更に、本実施形態例１では、フェルール１３の先端外周部に、先端周縁１２ａに向かって先細りとなるテーパ面１５が形成されている点も、従来の技術で説明したフェルール４と異なっている。このテーパ面１５としては、フェルール１３の軸線を通る断面（図１に示す断面）で見た場合、前記軸線に垂直な仮想平面とのなす角度αは、フェルール先端部の製造の難易度、充填材のはみ出し部の剥離性、フェルールと結合されるレセプタクルの形状等を考慮して、０度＜α＜９０度の範囲から適宜設定されるが、製造が容易であるため、１０度～６０度の範囲であることが好ましい。

【００２６】以下に詳細な説明を行うと、まず、ガイド孔１２内に、光ファイバ１０を同軸に挿入し、その端面１０ａを先端周縁１２ａにできるだけ近付けてから、かしめ等によって光ファイバ１０を被覆する図示されないジャケットをＦ０７コネクタプラグに抜出不可に固定する。その後、フェルール１３及びガイド孔１２が加熱面１１に対して垂直をなすように加熱面１１の上方にフェルール１３を保持すると共に、充填材１４を、光ファイバ１０の端面１０ａと加熱面１１との間に位置するように加熱面１１上に載置することで、図１に示す押し当て前の状態となる。

【００２７】ここで用いられる充填材１４はビーズ形状を有するものであり、その材質としては、光ファイバ１０のコアと同じ光学的特性（少なくとも屈折率が同じであること）と、同じ熱的特性（熱収縮率等が同じである）とを有していることが好ましく、コアと同材質とすることがより好ましい。

【００２８】次に、加熱面１１に対する垂直状態を保ったままフェルール１３を下降させて、先端周縁１２ａと加熱面１１との間に充填材１４を挟み込む。このときの充填材１４は、例えば約１６０℃に加熱された加熱面１１からの伝熱により溶融しており、光ファイバ１０の端面１０ａに形成された凹凸の凹部内に流れ込んでこれを満たすと共に、余分となったものは、先端周縁１２ａと加熱面１１との間から外部に押し出されてはみ出し部１４ａとなる。

【００２９】更に押し当てを進めると、図２に示すように、先端周縁１２ａが加熱面１１に緊密に当接し、はみ出し部分１４ａが光ファイバ１０本体より分断されると共に、充填材１４の加熱面１１に接している面が、平滑な加熱面１１に密着して平滑に端面処理される。

【００３０】この押し当ての際の、ガイド孔１２内に充填された充填材１４は、光ファイバ１０の径方向に広がろうとしても、ガイド孔１２による規制を受けているので、広がることができないようになっている。これにより、光ファイバ１０の先端部分は、従来のようにその断面形状が末広がりに大きくならず、一定外径断面を維持した直円柱形状に成形される。この後、図２の押し当て状態を保ったまま加熱面１１の加熱を止めることで、充填材１４は、放熱冷却により固化し、平滑で、かつフェルール１３の先端周縁１２ａを周縁とする平坦面１６を形成する。この時、はみ出し部１４ａも同時に固化する。

【００３１】そして、図３に示すように、フェルール１３を加熱面１１の上方に上昇させることで、はみ出し部１４ａが取り除かれ、取り付け作業が完了する。このとき、はみ出し部１４ａがフェルール１３に付着したとしても、その付着力は後述される理由により強いものではないので、エアーの吹き付け等で簡単に取り除かれる。この取り付け後のＦ０７コネクタプラグは、図示されないレセプタクルにおいて他の光ファイバと突き合わせ接続され、この接続部分を介して通光され、他端から出てくる光量を測定することで、結合損失の評価が行われる。

【００３２】本実施形態例１の光ファイバの端面処理方法によれば、光ファイバ１０のコアと同屈折率を有する充填材１４を溶融させて光ファイバ１０の端面１０ａの

不足部分を充填することで、前記不足部分が充填材１４で満たされて平滑に成形されるので、光伝送能力に支障を来すことがなく、かつ従来のように光ファイバ１０の先端の突き出し長さを制御する必要もない。

【００３３】また、本実施形態例１の光ファイバの端面処理方法によれば、フェルール１３の先端外周部を、先端周縁１２ａに向かう先細り形状のテーパ面１５とすることで、鋭利な先端部となるので、先端周縁１２ａと加熱面１１を当接させることにより、はみ出した余分なはみ出し部１４ａを容易かつ確実に切断することが可能となる。さらに、このテーパ面１５は加熱面１１に当接しないので、はみ出し部１４ａを必要以上に圧迫してこれがフェルール１３の先端部に貼り付きやすくなるのを防ぐことが可能となり、エアーの吹き付け等によりフェルール１３から容易にはみ出し部１４ａを除去することが可能となる。

【００３４】また、本実施形態例１の光ファイバの端面処理方法によれば、充填材１４の材質を光ファイバ１０のコアの材質と同じにすることで、充填材１４が充填された部分の、屈折率等の光学的特性が光ファイバ１０のコアと同じになるので、光伝送能力を低下させることがない。更には、充填材１４が充填された部分の、熱収縮率等の熱的特性も光ファイバ１０のコアと同じになるので、冷却後に端面１０ａから剥がれ落ちるなどの不具合を防ぐことも可能となる。

【００３５】［実施形態例２］次に、図４～図６を参照しながら、本発明の実施形態例２について以下に説明を行う。なお、本実施形態例２において、上記実施形態例１の図１～図３で説明したものと同一構成要素には同一符号を付し、その説明を省略する。

【００３６】本実施形態例２では、上記実施形態例１に比較して、フェルール１３の先端部分にテーパ面１５ではなく中空円形状の先端面２０が形成されている点と、ガイド孔１２の内径寸法ｄ１（例えば１ミリメートル）と略同じ外径寸法ｄ２（例えば１ミリメートル）の円形の加熱面２１ａを上端面とする円柱形状突起（柱状体）２１が形成されている点と、シート形状（例えば厚さ１００マイクロメートル）の充填材２２を採用している点とが異なっている。

【００３７】まず、ガイド孔１２内に光ファイバ１０を挿入し、かしめ等によって光ファイバ１０をＦ０７コネクタプラグに抜出不可に固定する。その後、フェルール１０及びガイド孔１２が加熱面２１ａに対して垂直をなすように加熱面１１の上方にフェルール１３を保持すると共に、シート形状の充填材２２を、光ファイバ１０の端面１０ａと加熱面２１ａとの間に位置するように加熱面２１ａ上に載置することで、図４に示す押し当て前の状態となる。

【００３８】ここで用いられる充填材２２の材質としては、実施形態例１と同様に、光ファイバ１０のコアと同じ光学的特性（少なくとも同じ屈折率である）と同じ熱的特性（熱収縮率等が同じである）とを有していることが好ましく、コアと同材質とすることがより好ましい。

【００３９】次に、フェルール１３を下降させて、先端周縁１２ａと加熱面２１ａとの間に充填材２２を挟み込む。このときの充填材２２は、例えば約１６０℃に加熱された加熱面２１ａからの伝熱により溶融しており、光ファイバ１０の端面１０ａに形成された凹凸の凹部内に流れ込んでこれを満たすと共に、余分となったものは、先端周縁１２ａと加熱面２１ａとの間から外部に押し出されてはみ出し部２２ａとなる。更に押し当てを進めると、先端周縁１２ａと加熱面２１ａの周縁２１ｂとが合致し、これらが、刃としてはみ出し部２２ａを切り取ることで、図５に示す押し当て状態となる。

【００４０】この押し当ての際に、ガイド孔１２内に残った充填材２２は、ガイド孔１２による規制を受けているので、径方向に広がることができないようになっている。これにより、光ファイバ１０の先端部分は、従来のようにその断面形状が末広がりに大きくならず、一定外径断面を維持した直円柱形状に成形される。この後、図５の押し当て状態を保ったまま、加熱面２１ａの加熱を止めることで、光ファイバ１０の先端部分は、放熱冷却により固化し、平滑で、かつフェルール１３の先端面２０と面一な平坦面２３を形成する。

【００４１】そして、図６に示すように、フェルール１３を加熱面１１の上方に上昇させることで、はみ出し部２２ａが取り除かれ、取り付け作業が完了する。このとき、はみ出し部２２ａがフェルール１３に付着していたとしても、その付着力は上記実施形態例１で説明したと同じ理由により強いものではないので、エアー等の吹き付けを行うことで、簡単に取り除かれる。この取り付け後のＦ０７コネクタプラグは、図示されないレセプタクルにおいて他の光ファイバと突き合わせ接続され、この接続部分を介して通光され、他端から出てくる光量を測定することで、結合損失の評価が行われる。

【００４２】本実施形態例２によれば、上記実施形態例１と同様の効果を得ることができる。さらに、本実施形態例２によれば、加熱面２１ａの周縁２１ｂとガイド孔１２の先端周縁１２ａとを合致させることで、これらが、充填材２２のはみ出し部２２ａを切り取る刃の役目をするので、容易かつ確実にはみ出し部２２ａを取り除くことが可能となる。さらに、フェルール１３の先端面２０は加熱面２１ａに当接しないので、必要以上にはみ出し部２２ａを圧迫してこれがフェルール１３の先端面２０に貼り付きやすくなるのを防ぐことが可能となり、エアーの吹き付け等によりフェルール１３から容易にはみ出し部２２ａを除去することが可能となる。

【００４３】なお、上記実施形態例１及び上記実施形態例２の光ファイバの端面処理方法においては、Ｆ０７コネクタプラグに光ファイバ１０を取り付ける場合を例に

説明を行ったが、Ｆ０７コネクタプラグに限らず、その他のタイプの光コネクタへの取り付けに本発明を適用しても良い。

【００４４】また、上記実施形態例１及び上記実施形態例２では光ファイバ保持部としてフェルール１３を用い、フェルール１３内の孔をガイド孔１２とし、成端後にそのままＦ０７コネクタプラグに固定するものとしたが、これに限らず、ガイド孔１０を有する治具（図示せず）を用意し、これを光ファイバ保持部としてフェルール１３の代わりに用いて上記実施形態例１及び上記実施形態例２と同様に、そのガイド孔１２内に光ファイバ１０を挿入して成端し、成端後にガイド孔１２内から引き抜いて、これを光コネクタ等に挿入して固定する２段式の成端方法を採用しても良い。

【００４５】また、上記実施形態例１では、ビーズ形状の充填材１４を用いたが、シート形状の充填材２２など、その他の形状のものを使用しても良い。また、逆に、上記実施形態例２では、シート形状の充填材２２を用いたが、ビーズ形状の充填材１４など、その他の形状のものを使用しても良い。

【００４６】また、上記実施形態例１の加熱面１１は平坦であったが、上記実施形態例２に示したように円柱形状突起２１の円形の端面を加熱面２１ａとして採用しても良い。また、逆に、上記実施形態例２では、円柱形状突起２１の上端面を加熱面２１ａとして使用したが、これに限らず、上記実施形態例１のような平坦な加熱面１１を用いても良い。

【００４７】また、上記実施形態例１では、フェルール１３として、その先端部分にテーパ面１５を有するものを使用したが、これに限らず、上記実施形態例２に示したような、中空円形状の平坦な先端面２０を有するものを使用しても良い。また、逆に、上記実施形態例２では、フェルール１３として、その先端部分に中空円形状の平坦な先端面２０を有するものを使用したが、これに限らず、テーパ面１５を有するものを使用しても良い。

【００４８】

【発明の効果】本発明の請求項１記載の光ファイバの端面処理方法によれば、光ファイバのコアと同屈折率を有する充填材を溶融させて光ファイバの端面の不足部分を充填することで、この不足部分が充填材で満たされて平滑に成形されるので、光伝送能力に支障を来すことがなく、かつ従来のように光ファイバの先端の突き出し長さを調節する必要をなくすことが可能となる。

【００４９】また、請求項２記載の光ファイバの端面処理方法によれば、フェルールの先端部を先細り形状のテーパ面形状とすることで、鋭利な先端部となるので、先端周縁と加熱面との間からはみ出した余分な充填材量を容易かつ確実に切断することが可能となる。さらに、このテーパ面は加熱面に当接しないので、はみ出した充填材を必要以上に圧迫してこれがフェルール先端部に貼り付きやすくなるのを防ぐことも可能となり、エアーの吹き付け等によりフェルールから容易に充填材のはみ出し部を除去することが可能となる。

【００５０】また、請求項３記載の光ファイバの端面処理方法によれば、柱状体の円形端面を加熱面として使用し、該加熱面の周縁とガイド孔の先端周縁とを合致させることで、これらが、充填材のはみ出し部を切り取る刃の役目をするので、容易かつ確実に充填材のはみ出し部を取り除くことが可能となる。さらに、フェルールの先端面は加熱面に当接しないので、はみ出した充填材を必要以上に圧迫してこれがフェルールの先端面に貼り付きやすくなるのを防ぐことも可能となり、エアーの吹き付け等によりフェルールから容易に充填材のはみ出し部を除去することが可能となる。

【００５１】また、請求項４記載の光ファイバの端面処理方法によれば、充填材の材質を光ファイバのコアと同じ材質にすることで、充填材が充填された部分における屈折率等の光学的特性が光ファイバ本体のコアと同じになるので、光伝送能力を低下させることがない。更には、充填材が充填された部分における熱収縮率等の熱的特性も光ファイバ本体のコアと同じになるので、冷却後に光ファイバの端面から剥がれ落ちるなどの不具合を防ぐことも可能となる。

【図面の簡単な説明】

【図１】　本発明の光ファイバの端面処理方法の実施形態例１の工程を示す図であって、側断面図である。

【図２】　同光ファイバの端面処理方法の次の工程を示す図であって、側断面図である。

【図３】　同光ファイバの端面処理方法の次の工程を示す図であって、側断面図である。

【図４】　本発明の光ファイバの端面処理方法の実施形態例２の工程を示す図であって、側断面図である。

【図５】　同光ファイバの端面処理方法の次の工程を示す図であって、側断面図である。

【図６】　同光ファイバの端面処理方法の次の工程を示す図であって、側断面図である。

【図７】　従来の光ファイバの端面処理方法の工程を示す図であって、斜視図である。

【図８】　同光ファイバの端面処理方法の次の工程を示す図であって、斜視図である。

【図９】　同光ファイバの端面処理方法の次の工程を示す図であって、側断面図である。

【図１０】　同光ファイバの端面処理方法の次の工程を示す図であって、側断面図である。

【図１１】　同光ファイバの端面処理方法の変形例を示す図であって、側断面図である。

【符号の説明】

１０…光ファイバ

１０ａ…端面

１１…加熱面

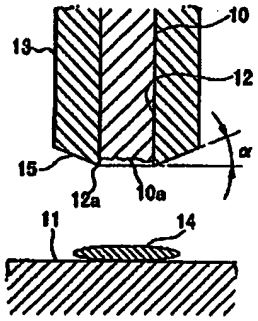
11

１２…ガイド孔
１４、２２…充填材
１２ａ…先端周縁
１３…フェルール、光ファイバ保持部
１５…テーパ面

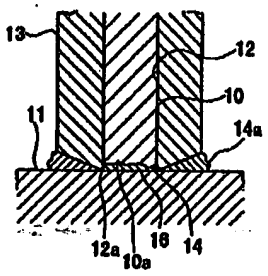
12

＊ｄ１…内径寸法
ｄ２…外径寸法
２１ａ…円形端面（加熱面）
２１…円柱形状突起（柱状体）
＊

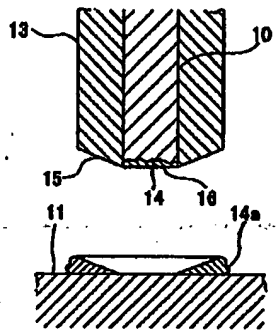
【図１】



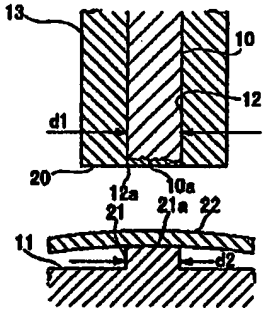
【図２】



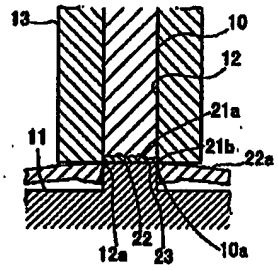
【図３】



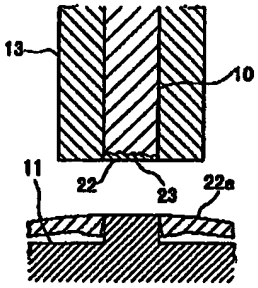
【図４】



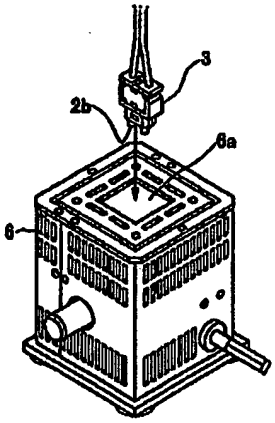
【図５】



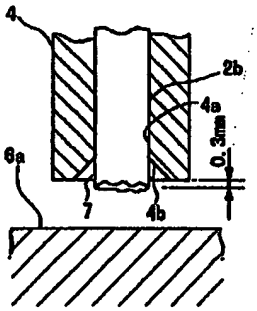
【図６】



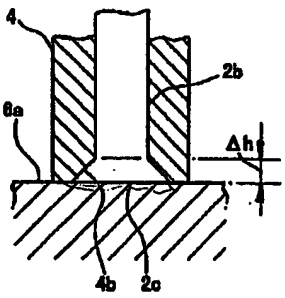
【図８】



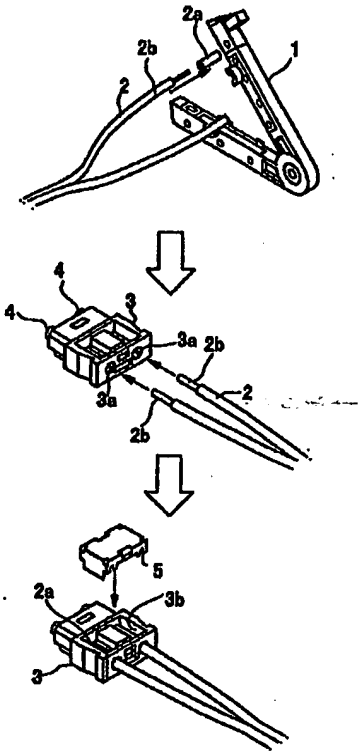
【図９】



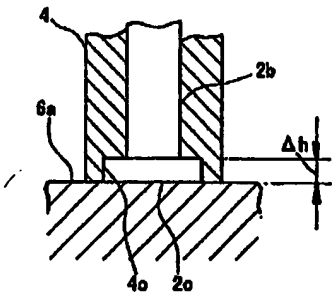
【図１０】



【図７】



【図１１】



フロントページの続き

(72)発明者 杉浦 正行
愛知県豊橋市牛川通四丁目１番地の２ 三菱レイヨン株式会社豊橋事業所内

Ｆターム(参考) 2H036 KA03 QA14 QA21
2H050 AA13 AB43Z AB47Z AC87
AC90